CROP-LIVESTOCK PRODUCTION SYSTEM FOR FATTENING LAMBS UNDER DESERT FARMING

BY

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ABSTRACT

The present study was designed to investigate the response of growing lambs to different feeding systems under desert agriculture conditions. Two hundred and fifty five Barki lambs with an average live body weights 31.27 ± 0.52 kg were used in feeding trials lasted 120 days. Animals were divided into three similar groups (85 lambs each). The feeding systems based on grazing the lower portion of alfalfa remaining after cattle grazed the fodder in addition to different experimental rations: RI, Concentrate feed mixture (CFM) + wheat straw (control). RII, Cracked barley grain (BG) + wheat straw (WS). RIII, CFM and BG 2: 1 ratio + wheat straw. The concentrate portion was fed at a level 2% of animals live body weight with *ad libitum* wheat straw. By the end of feeding trial, three digestibility trials were carried out using twelve Barki lambs to evaluate the previous rations by using acid insoluble ash (AIA) technique. Rumen liquor samples were collected at the last day of digestion trials. Results indicated that, all nutrients digestibility were ($P<0.01$) significantly lower for RI (contained CFM) compared to RIII (CFM and BG). Ration II (contain BG) had intermediate values between the lowest values for RI and the highest values for RIII. The differences between neither RI and RII nor RII and RIII were not significant for DM, OM and EE digestibilities. Moreover, no significant difference was detected between RI and RII for DM, OM, CP, CF and EE digestibilities. Nutritive value (TDN and ME) were significantly ($P<0.01$) higher for RIII than the other two rations. No significant differences were observed among the different feeding groups in ruminal pH values. Ammonia-N and total volatile fatty acids concentrations were significantly ($P<0.01$) increased for the experimental rations (II and III) compared to the control ration (I). Average daily gain was 135, 155 and 178 g/day for lambs fed rations I, II and III, respectively. It increased by 14.8 and 31.9 % for rations II and III compared to the control ration (I). Feed conversion efficiency values (kg DM/kg gain) for animals fed the experimental rations (RII or RIII) were better than those fed the control ration, it improved by 4.0 and 13.7 % for rations II and III, respectively. Moreover, economical efficiency improved by 30.5 and 17.0 %, while feed

cost, as LE/kg gain was decreased by 23.2 and 14.3 % for lambs fed rations II and III, respectively compared to the control ration.

Keywords: lambs, grain barley, digestibility, feeding value, rumen fermentation, daily gain.

INTRODUCTION

The gab between the available feed and the nutritional requirements of livestock production in Egypt is well recognized. In typical production system, ruminants derive most nutrients from forages. With increased demand of fodder crops, the market price of these crops gives the farmer an incentive to grow more fodders in the Delta and Valley at the expensive of food and cash crops. Therefore, growing fodder crops for animal production in newly reclaimed desert area is one of the efforts to cover the serious shortage of animal feed in Egypt. Recently, Egyptian government started in a great reclamation project in Upper Egypt (Wady El-Saaida, Sharq Ewinat and Toshka). Livestock feeding strategies must be developing based on currently or potentially available local sources. It is more local and profitable for developing countries to adapt animal production system to available feed resources than vice versa.

The fibrous by-products resulting from crop cultivation constitute a major source of nutrients for animal production in developing countries. It is argued that the importance of crop residues as feed differs between production systems. Differences in production goals, resource endowments and socioeconomic conditions create different opportunities for the use of crop residues. Williams et al. (1997) reported that in designing research and extension programs that seek to improve use of crop residues as livestock feed, it is pertinent to identify the main livestock production system, farmers production objective and resource endowments and determine the appropriate crop-residue-based diet for each system.

Ruminants serve a valuable role in sustainable agriculture system. They are particularly useful in converting vast renewable resources from crop residues into food edible for human (Oltjen and Beckett, 1996). The system of feeding cattle and sheep at South Tahrir of the Desert Development Centre (DDC) farm is depended mainly on grazing some fodder crops in addition to the crop residues which is considered an economical system for raising farm animals in the new reclaimed desert area. For achieving more efficiency of grazing operation, sheep graze on the same fodder crop area which has already been grazed by cattle. Gertenbach et al. (1998) found that cattle alone or cattle with sheep had a

large live mass gain/ha than sheep only grazing the crop residues. Mosienyane (1983) reported that crop residues from 6 ha would feed a herd of 50 cattle for more than two months. Mohamed (1996) noticed highly significant differences in daily gain of lambs fed on grazing the lower portion of alfalfa after alfalfa was being grazed by calves and unsupplemented or supplemented with cracked barley, wheat bran, barley-wheat bran (1:1) or concentrate feed mixture. The highest daily gain (158 gm) was for group supplemented with barley while unsupplemented group gave the lowest daily gain (75 gm) which was due to the lower of dietary energy.

The objective of this investigation is to study the response of growing Barki lambs to the different feeding systems under the desert agriculture conditions.

MATERIALS AND METHODS

This study was carried out on the sheep flock at south Tahrir in the Desert Development Centre (DDC) belonging to the American University in Cairo (AUC) and Department of Animal Production, Faculty of Agriculture, Kafr El-Sheikh, Tanta University. Two hundred and fifty five Barki lambs with an average live body weight (LBW) 31.27 ± 0.52 kg and aged 5-6 months was used in feeding trials lasted 120 days. Animals were divided into three similar groups (85 lambs each) to study the response of growing lambs to different feeding systems. The feeding systems of lambs were as follows: RI. Concentrate feed mixture (CFM) + wheat straw (control). RII. Cracked barley grain (BG) + wheat straw (WS). RIII. Mixture of CFM and BG at 2: 1 ratio + wheat straw. The concentrate portion was fed at level 2% of LBW with *ad libitum* wheat straw. The animals in all groups were fed on grazing the lower portion (residue) of the alfalfa after the forage crop had being grazed by cattle. The daily grazing period was three hours and the quantity of fodder consumed was about 2 kg/ lamb during the morning period. Fodder intake was estimated according to cut and weight of different specific areas that grazed by cattle. Fresh water and trace mineralized salt blocks (Biomix 112, Biochema, Cairo, Egypt) were available all the day. Each kg of Biomix 112 contains S 6000 mg, Fe 3500 mg, Zn 3000 mg, Mn 3000 mg, Mg 1000 mg, Ca 800 mg, Se 6 mg, Molasses 500mg).

Animals were weighed before morning feeding on two consecutive days at the beginning and at the end of the feeding trial and once biweekly during the experimental period. The amount of concentrate was

changed bi-weekly according to change in the live body weight. Feed intake, feed conversion efficiency and economical efficiency were calculated. At the end of feeding trial, twelve Barki lambs were used for carrying out three digestion trials (each of 4 animals) to evaluate the experimental feeding treatments by using acid insoluble ash (AIA) technique as a natural marker (Van Keulen and Young, 1977). Samples of feed ingredients and feces were taken for chemical analysis according to AOAC (1990).By the last day of the digestibility trials, rumen liquor samples were taken 3hrs after the morning feeding using a rubber stomach tube. Ruminal pH value was determined directly by using Beckman pH meter. However, 1 ml concentrated saturated mercuric chloride was added to the rest of sample to stop the microbial activity, filtered through a double layers of cheesecloth and stored in polyethylene bottles in freezer until analysis. Total volatile fatty acids (VFA's) concentration was estimated by using steam distillation method (Warner, 1964). Ammonia-N (NH_3-N) concentration was determined by using magnesium oxide (MgO) as described by AOAC (1990).

The data were statistically analyzed using General Linear Models Procedure (one way ANOVA model) adapted by SPSS (1997), while appropriate means were separated using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

1- Chemical composition

The chemical composition of the different ingredients and the calculated rations (Table 1) cleared that the CFM had a higher crude protein (CP) and crude fiber contents (13.96 and 12.54%, respectively) than BG (11.65 and 8.24%, respectively), while it contains lower amount of nitrogen free extract (61.37%) compared to BG (74.18%). Wheat straw contains the highest crude fiber content followed by the lower portion of alfalfa. This was reflected on the chemical composition of the tested rations, particularly nitrogen free extract (NFE) content whereas RI (contained CFM) had the lowest content of NFE (51.04%), while RII (contained BG) had the highest one (58.05%), RIII (contained both of BG and CFM) was intermediate (54.14). The chemical analysis of CFM, BG and WS were within the wide range obtained by Lashien et al. (1995); Hanafy et al. (1998); Shawket et al. (2001) and Zaki el al. (2001). Data also revealed that, the lower portion of alfalfa contained lower CP (12.95%) and higher CF (34.25%) than those found for the whole alfalfa plant being 18.59% for CP and 22.42% for CF (Mahmoud et al., 1998).

Table (1): Chemical composition of the feed ingredients and testea rations.

Item	DM, %	DM composition, %					
		OM	CP	CF	EE	NFE	Ash
Concentrate feed mixture*	88.72	90.68	13.96	12.54	2.81	61.37	9.32
Cracked barley	93.45	96.93	11.65	8.24	2.86	74.18	3.0
Wheat straw	95.35	89.35	2.78	38.45	1.58	46.54	10.65
Alfalfa (lower portion)	28.45	89.91	12.38	34.42	1.67	41.44	10.09
Tested rations (calculated)							
R I	46.81	90.25	11.92	25.04	2.25	51.04	9.75
R II	49.70	93.28	10.79	22.13	2.31	58.05	6.72
R III	49.93	91.30	11.53	23.39	2.24	54.14	8.70

* The ingredients of concentrate feed mixture (CFM) were 40% undecorticated cotton seed meal, 30% wheat bran, 15% tapioca, 10% yellow corn, 3% vinase, 1.5% limestone and 05% common salt.

R I: Concentrate feed mixture + wheat straw with grazing lower portion of alfalfa (control)

R II: Cracked barley + wheat straw with grazing lower portion of alfalfa.

R III: Mixture of concentrate feed mixture and cracked barley at 2: 1 ratio + wheat straw with grazing lower portion of alfalfa.

2-Digestibility and nutritive values

The average digestibility coefficients of the experimental rations are presented in Table (2). The digestibility of all nutrients significantly ($P<0.01$) decreased for lambs fed RI (contained CFM) compared to those fed RIII. Ration II had intermediate values. The differences between neither rations I and II nor rations II and III were not significant for DM, OM and EE digestibilities. Moreover, no significant differences were detected between rations I and II for DM, OM, CP, CF and EE digestibilities. These results are in accordance with those reported by Lashien et al. (2001) who revealed that there are no significant differences between the digestibility coefficients for CFM and BG diets for DM, OM, CP and NFE when concentrate potion was used at 2% of live body weight with barley straw.

Data concerning nutritive value (Table 2) showed that, TDN and ME values were significantly ($P<0.01$) higher for RIII than the other rations (I and II). The high TDN values for the rations contain BG or mixture of CFM and BG may be due to the high percentage of NFE in BG (74.18%). Furthermore, DCP value was also higher ($P<0.01$) for RIII compared to the two other rations (9.03 vs. 7.36 and 7.62%) while no significant differences were observed between RI and RII. These findings are in agreement with

those reported by Lashien et al. (2001). Etman et al. (2001) noticed higher digestibility coefficients of DM, OM, CP and EE when used two different sources of energy (yellow corn and sorghum grains) in buffalo calves rations.

Table (2): Digestibility coefficients and nutritive values for the different experimental rations

Item	Experimental rations			SEM*
	I	II	III	
Digestibility coefficients, %				
DM	58.77^{b}	65.37^{ab}	71.90^{a}	2.02
OM	62.14^{b}	69.93^{ab}	76.03^{a}	1.94
CP	63.95^{b}	68.19^{b}	78.24^{a}	2.01
CF	55.01^{b}	56.51^{b}	67.30^{a}	1.69
EE	72.92^{b}	74.63^{ab}	83.73^{a}	1.84
NFE	67.57^{c}	74.94^{b}	82.68^{a}	1.98
Nutritive values				
TDN, %	59.58^{c}	67.25^{b}	73.75^{a}	1.82
ME, Mcal/ kg DM**	2.15^{c}	2.42^{b}	2.65^{a}	0.06
DCP, %	7.62^{b}	7.36^{b}	9.03^{a}	0.24

^{a,b,c} Means within a raw with different superscripts are significantly different at (P<0.01).

*SEM: Standard error of mean.

**ME, Mcal/ kg DM= (TDN× 3.6)/100 (Ranjhan, 1980 and Church and Pond, 1982).

3-Rumen fermentation

The results of Table (3) showed that, no significant differences were observed among the different feeding groups in ruminal pH values. On the contrarily, NH_3-N concentration was decreased ($p< 0.01$) for the control ration (contained CFM) compared to the other rations. The high ammonia concentration for rations II and III, which contained BG may be due to the high level of NFE, which is rapidly fermented and went through rumen, in the same time ammonia produced from fermented roughages, did not find soluble carbohydrate to produce microbial protein. In addition to the higher DMI (Table 4) that led to increase the nitrogen intake for lambs fed RII and III compared to those fed the RI. Lashien et al. (2001) stated that feeding lambs on ration contained 2% BG from their LBW with *ad libitum* barley straw increased ammonia concentration compared to the other rations that contained either CFM or mixture of barley grain and CFM. Moreover, the present results are in

accordance with those reported by Mehrez et al. (1977) and DeFaria and Herber (1984). The concentration of total volatile fatty acids were (VFA`s) significantly (P<0.01) increased for the experimental rations (II and III) compared to the control ration, which may be attributed also to the higher energy content of BG that led to increase the efficiency of energy utilization by lambs, caused an increase of ruminal VFA`s concentration. These results are agreed with those obtained by Punia and Sharma (1990) who reported that total VFA concentration and its production rate were higher (P<0.01) for barley and molasses as source of energy than for straw supplement diets. El-Badawi et al. (2001) indicated that the ruminal fermentation pattern with barley based diets was higher (P<0.05) for NH_3-N and (P<0.01) for VFA`s concentration when fed with soybean meal. Fahmy et al. (2001) noticed higher ruminal increment of VFA`s concentration when lambs were fed monensin with dry halophytic mixture than halophytic alone with based-CFM-diet.

Table 3: Average values of rumen liquor parameters of Barki lambs consumed different experimental rations.*

Items	Experimental rations			SEM
	I	II	III	
pH	6.08	6.34	6.55	0.04
NH_3-N, mg/100 ml	21.75^b	34.39^a	33.71^a	2.04
VFA`s, meq /100 ml	10.27^c	12.70^b	13.69^a	0.71

[a, b, c] Means within a raw with different superscripts are significantly different at (P<0.01).
*Each value represents a mean of four values.

4- Growth performance and feed conversion

Data in Table (4) indicated that total feed intake (kg DM, head/day) was 1.33, 1.47 and 1.52 for rations I, II and III, respectively. It increased by 10.53 and 14.29 % for rations II and III, respectively compared to RI (control). However, average daily gain (ADG) was 135, 155 and 178 g for lambs feed rations I, II and III, respectively. It increased by 14.8 and 31.9 % for rations II and III compared to the control ration, this may be due to incorporation the barley into the diets, which is, considered a good palatable feed as well as due to its higher energy content that reduce the loss of protein from the rumen and caused an increase of ruminal VFA`s concentration. Differences among the different tested groups were highly (P<0.01) significant. These results are in agreement with those reported by Mahmoud et al. (1998) who found that average daily gain of Barki lambs grazed the lower portion of alfalfa and supplemented with BG or wheat bran or mixture of barley-wheat bran (1:1) or concentrate feed mixture (14% CP) at 1.5% of live body weight was 158, 115, 121 and 129 g for the

different supplementation, respectively. It is evident that the barley was superior to both of wheat bran and concentrate feed mixture in fattening lambs. Karnezos et al. (1994) indicated that supplementing lambs grazing alfalfa with limited amount of corn (250 g/lamb/day) increased lamb growth rate seemingly through a more efficient use of pasture protein. Moreover, Dennis and Mclennan (1995) reported that energy supplementation is a strategy that could be used to reduce the loss of protein from the rumen when feeding legumes.

Table (4): Feed intake, daily gain, feed conversion and economical efficiency for lambs fed different experimental rations

Item	Feeding groups			SEM
	G I	G II	G III	
Initial wt., kg	30.33	31.44	32.05	0.52
Final wt., kg	46.53	50.04	53.35	0.42
Total gain, kg	16.20	18.60	21.3	0.52
Daily gain, g	135[c]	155[b]	178[a]	2..34
DM intake, kg/ head/ day				
Concentrate feed mixture	0.603	--	0.492	--
Cracked barley	--	0.720	0.259	--
Wheat straw	0.162	0.184	0.198	--
Lower portion of alfalfa	0.569	.569	0.569	--
Total feed intake, kg	1.334	1.473	1.518	--
Roughage, %	54.80	51.12	50.53	--
Feed conversion efficiency, kg/ kg gain				
DM	9.88	9.50	8.53	--
Feed cost, LE/ head/ day	0.744	0.656	0.84	--
Feed cost, LE/ kg gain*	5.51	4.23	4.72	--
Economical efficiency**	2.72	3.55	3.18	--

[a,b,c] Means within a raw with different superscripts are significantly different at ($P<0.01$).

* Based on the assumption that prices of each one ton from concentrate feed mixture, barley grains and wheat straw were 1050, 800 and 200 LE, respectively and one kg body weight on selling was 15 LE in year 2005.

** Economical efficiency = Money output (price of weight gain)/ Money input (price of feed consumed.

Feed conversion efficiency (kg DM/kg gain) for animals fed the experimental rations (II and III) was better than those fed the control ration, it was improved by 4 and 13.7 % for rations II and III, respectively. However, economical efficiency improved by 30.5 and 17 % and feed cost, as LE/kg gain decreased by 23.2 and 14.3 % for lambs fed rations II and

III, respectively compared to the control ration. From these results, it could be noticed that feeding lambs on BG improved feed efficiency; increased average daily gain and lowered overall feed cost per kg of gain compared to CFM. These results are in harmony with findings obtained by Hanafy et al. (1998) and Lashien et al. (2001), who reported that the feed utilization efficiency for CFM is lower than barley grain. On the other hand, several studies have shown improvements in the performance of animals as a result of addition the barley variety (Ovenell and Nelson, 1992; Bradshaw et al., 1992 and Talat Guler et al., 1999).

According to the results obtained in the present study, it could be recommended to replace concentrate feed mixture by BG (one of the available crop found in newly reclaimed desert area) as a source of concentrates for growing lambs to produce the cheapest live body weight gains. Moreover, data also showed that for higher gain rate the energy requirements for fattening lambs should be 2.4-2.6 ME/kg DM. On the other hand, the present data confirmed the integrated system of grazing cattle and sheep under irrigated farming system in the new reclaimed desert area in which alfalfa is the main fodder crop. Moreover, grazing the residue of alfalfa by lambs after being grazed by cattle resulted also in an increase in alfalfa production in the new subsequent cuts.

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الملخص العربي

نظم تسمين الحملان تحت نظم الزراعة الصحراوية

نبيل محمد عويضة، محمد سعيد صالح، سعيد أحمد محمود
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صُمّمتْ هذه الدراسة لمعرفة مدى استجابة الحملان النامية لنظم التغذية المختلفةِ تحت ظروف الأرضي المستصلحة (ظروف الزراعةِ الصحراوية). استخدم في هذه الدراسة ٢٥٥ من الحملان البرقي متوسط وزنَ الجسم ٣١,٢٧ ± ٠,٥٢ كجم في تجربة نمو لمدة ١٢٠ يومَ. قُسّمتْ الحيوانات إلى ثلاث مجموعاتٍ متماثلة (٨٥ حمل في كل مجموعة). وكان نظام التغذية المتبع يعتمد على رعي الحملان لبقايا البرسيم الحجازي المتبقية بَعْدَ رَعيْ الأبقار. وكانت العلائق التجريبية كالآتي: ١- العلف المركز الحكومي (١٤% بروتين). ٢- الشعير المجروش. ٣- مخلوط العلف المركز الحكومي والشعير المجروش بنسبة ١:٢ على التوالي وكان الجزء المركز يعطى بمعدل ٢% من وزن الحيوانات مع تبن القمح حتى الشبع. في نهاية التجربة تم اختيار ١٢ حمل عشوائيا (٤ من كل مجموعة) لأجراء ٣ تجارب هضم لتقييم العلائق السابقة باستخدام طريقة AIA مع أخذ عينات من سائل الكرش في نهاية التجربة. وأشارت النتائج إلى:-

١. انخفضت معظم معاملات هضم المركبات الغذائية وكذلك القيمة الغذائية في صورة المركبات الغذائية المهضوم (TDN) أو الطاقة القابلة للتمثيل (ME) أو البروتين الخام المهضوم (DCP) بالنسبة للعليقة الضابطة بالمقارنة بالعليقة الثالثة في حين كانت تلك القيم بالنسبة للعليقة الثانية قيم وسطية بين العليقة الضابطة (أقل القيم) والعليقة الثالثة (أعلى القيم). كما لم يكن هناك اختلافات معنوية بين العليقة الأولى والثانية من ناحية وبين العليقة الثانية والثالثة من ناحية أخرى بالنسب لمعاملات هضم المادة الجافة والمادة العضوية والدهن الخام.
٢. لم يلاحظ أي اختلافات معنوية بين المجموعات المختلفة في درجة حموضة سائل الكرش في حين ازداد معنويا (١%) تركيز كلا من نتروجين الأمونيا والأحماض الدهنية الطيارة الكلية بالنسبة للحيوانات التي غذيت على العليقة الثانية والثالثة بالمقارنة بتلك التي غذيت على العليقة الضابطة.
٣. كان معدل النمو اليومي للحملان المغذاة على العليقة الأولى والثانية والثالثة ١٣٥، ١٥٥، ١٧٨ جم على التوالي. حيث تفوق معنويا (١%) بنسبة ١٤,٨، ٣١,٩% بالنسبة للحملان المغذاة على العليقة الثانية والثالثة على التوالي بالمقارنة بتلك التي غذيت على العليقة الضابطة.
٤. تحسنت الكفاءة التحويلية للغذاء (كجم مادة جافة/ كجم زيادة في وزن الحيوانات) بنسبة ٤، ١٣,٧% كما تحسنت الكفاءة الاقتصادية بنسبة ٣٠,٥، ١٧% في حين انخفضت تكلفة الغذاء (جنية/ كجم زيادة في وزن الحيوان) بنسبة ٢٣,٢، ١٤,٣% بالنسبة للحيوانات التي غذيت على العليقة الثانية والثالثة بالمقارنة بتلك التي غذيت على العليقة الضابطة.

من النتائج السابقة فأنه ينصح بإحلال الشعير (أحد المحاصيل التي تجود زراعته في المناطق الحديثة الاستصلاح وأيضا المناطق الصحراوية) محل العلف المركز الحكومي كمصدر غذائي جيد في علائق الحملان النامية وذلك لتقليل تكاليف إنتاج الكيلو جرام من الوزن الحي من الأغنام.